WEIGHT PERCEPTION, WEIGHT ACCURACY AND ITS RELATIONSHIP TO FAMILY HISTORY OF CHRONIC DISEASE

A Thesis

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Abstract

Obesity is a major public health concern which results in many chronic diseases. The potential for family history to promote obesity and chronic disease requires investigation. The purpose of this study was to examine the accuracy of self reported weight and the relationship of family history of chronic disease with weight accuracy. We examined self-reported weight and measured weight in adults 20-55 years old from the 1999-2004 National Health and Nutrition Examination Survey. Accuracy of weight was determined using 5% of self-reported weight to measured weight. Family history of diabetes, osteoporosis, cardiovascular disease, and hypertension was determined based on self-report. There was a significant direct correlation between self-reported weight and actual weight ($R=0.977$, $P<0.001$). Overall, 78% reported their weight within 5% of actual weight. Males and Non-Hispanic Blacks were significantly more likely to overestimate their weight. Females were more likely to underestimate their weight, while Non-Hispanic Whites were less likely to underestimate their weight. Adults with a family history of diabetes were significantly more likely to underestimate their weight. No other differences existed for other diseases. While accuracy of weight was strong the presence of a family history of chronic disease did not relate to greater awareness of weight status.

Introduction

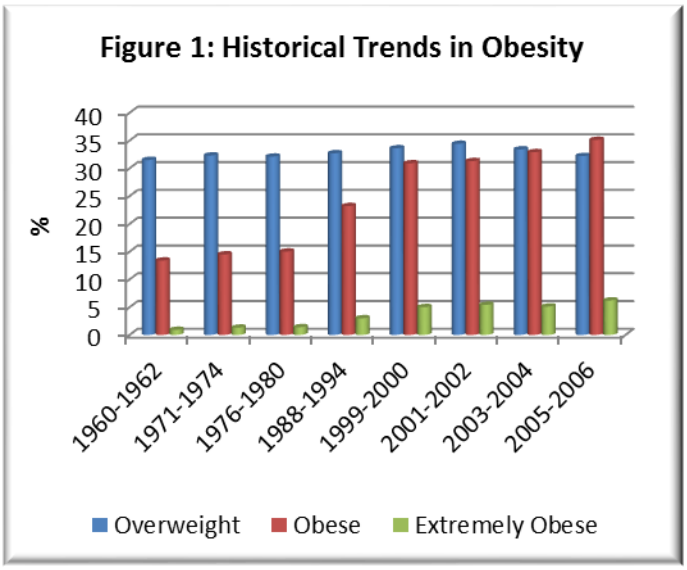
Obesity is an increasingly prevalent problem in developed nations such as the US, Canada, and Great Britain, as well as in the urban areas of many developing countries (1). It is also positively correlated to the acquisition of many health complications. Excess body fat is correlated with increased risk of type 2 diabetes mellitus, high blood pressure, hyperlipidemia, cancer, and depression (2). The World Health Organization estimates that by the year 2020, two-thirds of the world's disease will be non-communicable, chronic diseases such as those related to obesity (1).

Obesity's fundamental etiology is an energy imbalance, where energy intakes exceed energy output. The American Dietetic Association lists several other factors which lead to overweight and

obesity including family history, genetics, certain medications, social status, economic status, lifestyle habits, eating behaviors, stress, too little sleep, and various medical problems (3). The term obesigenic is often used to describe the current factors that lead modern individuals to consistently overeat. Obesigenic refers to an environment which persuades an individual towards eating greater portions of unhealthy foods, getting less physical activity and other behaviors which lead to weight gain (4). Such factors include the rise of high fat convenience food, increasing portion sizes, increased food availability, increased snacking, advertisement, and an increasingly sedentary lifestyle caused by the growing popularity of electronic media (2). Today's society has been called obesigenic, but the increase in overweight and obesity boils down to obesigenic factors within families. A study of families with obese children compared to families with normal weight children showed that parents of the overweight children had higher BMIs than the parents of normal weight children and that the households with higher weight children reported more psychological distress and family conflict (5). This study shows the significance of familial habits as barriers to the prevention of obesity.

An individual's body weight can be compared to a standard by utilizing a proportion of weight to height. This allows the person to be classified as underweight, normal weight, overweight, or obese and the classification can be useful in determining a person's weight related health risk. Body mass index (BMI) divides a person's weight in kilograms by their height in meters squared (kg/m^2). Weight classifications have been developed to assess BMI data, including underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2) and obesity (BMI ≥30 kg/m^2). Although body mass index does not take into account body composition and therefore may be skewed, for individuals with high muscle mass it is a good reference to classify weight of the average built individual. Using this scale, 68.8% of adult males and 61.7% of adult females in the US are either overweight or obese and 28.1% and 34.0% of adult males and adult females, respectively, are obese (1).

The National Health and Nutrition Examination Survey (NHANES) notes a consistent increase in overweight and obesity rates since their 1960-1962 study (6, Figure 1). The percentage of adults (age 20-74) who were overweight remained relatively stable with 31.5% in 1960-62 and 32.2% in 2005-06. The rate of obesity, however, drastically increased from 13.4% in 1960-62 to 35.1% in 2005-06. Extremely obese persons (BMI $\geq$ 40) increased from 0.9% in 1960-62 to 6.2% in 2005-06.



As noted previously, the environment of today's society supports weight gain in many individuals and more people are becoming overweight and obese. Therefore, rates of chronic diseases related to excess weight gain are likely to continue to rise (4). Concurrently, medical technology will improve and be able to assist those with chronic diseases with medical intervention (7). Medical advances have made treatment for chronic diseases related to obesity more available and therefore less will be done to prevent it (7). More money will be spent on health care and fewer preventative efforts will be made to stop chronic diseases before they start. These issues need to be addressed and altered in the present or the future will see an even greater increase in obesity and a decline in health.

Problem Statement

As individuals are getting fatter, overweight and obesity are becoming norms. Society is becoming more comfortable with being overweight and are denying the seriousness of the consequences it entails. As this normalcy settles in, people are losing sight of how their own body weight compares with a normal, healthy weight and cannot accurately identify their own health situation (8, 9, 10). Because much of the younger generation is heavier than their predecessors (6),

some have not seen ramifications of an unhealthy body weight. This investigation looked at the accuracy of weight perception of Americans and investigated whether those with an immediate family history of chronic disease (Type 2 Diabetes Mellitus, Angina or Cardiovascular Disease (CVD), Hypertension, and Osteoporosis) have a more accurate view of their weight. This was expected to be the case because if their family had experienced a circumstance in which overweight or obesity caused a health concern it would have made a more realistic impression upon them. A difference in weight perception between those with and without a family history chronic disease may create implications for the future of weight management counseling. Individuals with a less accurate perception may need to have a more emphasized education on the reality of their weight status and the associated risks. It may be pertinent to take a direct and somewhat aggressive approach to ensure that it is understood that excess body weight puts all individuals at increased risk for life threatening chronic diseases regardless of family history.

Related Research

Weight perception has been a common subject of research especially among subsets of the population with distinction made by a demographic characteristic such as age, race, gender or socioeconomic status. Research has suggested that various characteristics of a person influence their ability to accurately perceive their weight status and it has been shown that many people are unable to classify themselves as overweight when they actually are (8,9) and there is a positive correlation between the degree of overweight and the ability to recognize that status (10). One study showed that about half of overweight persons classify themselves as overweight while over 80% of obese persons say that they are overweight (10). This same study showed a lack of knowledge of weight status tools such as BMI and waist to hip ratio.

Other factors that influence weight perception include sex, age, income, race, and location of residence. Overweight men, blacks, those over 55 years old, those living in rural areas, and those making

<$35,000 per year were all more likely to inaccurately report themselves as being normal weight (8). While overweight black males are more likely to consider themselves as being a normal weight, studies suggest that in the adolescent population white females are more likely to misclassify their weight status (11). Adolescents are also more likely to classify themselves as overweight when they are medically classified as normal weight (12). One study has shown that the extent to which adolescents are trying to change their weight is dependent on the perception of weight status of their peers; therefore, at a school where a high percentage of children are overweight, it is less likely for one of them to be trying to lose weight (13). Other factors have also been shown to skew one's perception of weight status. One study identified regular exercise as a factor that caused overweight individuals to underestimate their weight category (8). A wide variety of factors play a role in the perception of one's weight and should be considered when planning weight management education.

There is an increasing knowledge of weight's effect on health status, however, not as much is being learned about what qualifies someone as overweight or obese in terms of BMI categories(10). Knowing that being overweight is a health concern is useless if one cannot accurately classify his own weight status. A person needs to be made aware of their weight status before they can appropriately decide what course of action to take. More needs to be learned about ways to increase accuracy of weight perception among all demographics.

It is known that biological relatives resemble one another more than non-relatives. This includes body shape and weight and makes it more likely for a person to be overweight or obese if their parents are. While a predisposition to weight gain may be present for these individuals, energy balance plays the final role in determining actual weight status. It is unknown what genes are connected to a predisposition of weight gain among obese relatives, but work is being done to learn more on the subject (14). While studies, such as identical twin tests, have shown that genetics play a role in obesity, family history may increase the chance of weight gain in other ways. It is known that having one or both

parents be obese greatly increases the odds of a child being overweight. This is likely a combination of genetics as well as a tendency for children to adopt their parents' habits. If parents create an obesigenic environment for themselves it will naturally become their child's environment as well (15). Once this child becomes an adult the habits are already established and will continue to pass through generations unless a significant effort is made to stop the cycle.

Similar to the increased risk of obesity with family history, chronic diseases are also typically seen in families. Because family members share genes and often environments and lifestyles, risk factors are usually common among relatives (16). A study of a diverse sample showed an association between family history of coronary heart disease (CHD) and coronary artery calcification. Regardless of other risk factors, those with a family history of CHD showed more calcification than those with no history of the condition (17). Similar findings have been shown relative to healthy individuals with family history of hypertension. Though all of the participants had normal blood pressure, those without family history of hypertension had lower blood pressure and better arterial integrity (18). Another study reported that African American adults with a family history of diabetes were more aware of their risk factors than those with no family history. They were also more likely to participate in preventative activities and eat more fruits and vegetables (19). These examples show that family history is a strong predictor for the development of chronic disease and that it may also increase awareness and the ability to take preventative measures.

The inability of persons to accurately perceive their weight status as well as a lack of understanding of weight status measures pose a great threat to the battle against obesity. The spread of these misperceptions among youths gives reason to believe that the problem is worsening rather than being alleviated. It is impossible for people to take charge of their health if they cannot accurately determine their risk. Because many people understand the correlation between family history of disease and their own risk, we hypothesize that individuals with a family history of weight related chronic

illnesses may have a more realistic impression of their own weight status. Therefore more information needs to be collected on the correlation between accuracy of weight perception and family history of obesity related disease.

Methods

Purpose and Objective:

The purpose of this investigation was to describe the relationship between actual and perceived weight status and to explain the relationship between family history of chronic disease and accuracy of weight perception.

Learning Objectives

1. Assess the current weight perceptions of US adults
2. Assess the current weight accuracy of US adults
3. Explore the relationship between immediate family history of obesity-related chronic disease and body weight perception accuracy.

Data Source

The information that was analyzed for this study was retrospective data from the National Health and Nutrition Examination Survey (NHANES). NHANES is a national nutrition survey conducted by the National Center for Health Statistics (NCHS) from the Centers for Disease Control and Prevention (CDC). The purpose of this national nutrition monitoring surveillance survey is to track the health and nutritional status and patterns of US population. Interviews are used to obtain demographic, health, socioeconomic, and nutrition related information and physical examinations are also conducted.

There were three NHANES surveys conducted between its implementation in 1971 and 1999. Beginning in 1999, NHANES became a continuous surveillance system. Data were collected on approximately 10,000 Americans during each two-year cycle of NHANES. To ensure representation of hard-to-reach populations, specific groups were oversampled: children, adolescents, low income, adults

60 years and older, black Americans, Mexican Americans and pregnant women. Information was collected by individuals trained by specialized standards. Initial interviews were collected during in home interviews and further interviewing, dietary recalls, and physical examinations are conducted in mobile examination centers (MEC, 1).

In this study, data collected from the 1999-2000, 2001-2002, and 2003-2004 NHANES were used due to their inclusion of questions related to family history of chronic illnesses including diabetes, hypertension, angina or CVD, and osteoporosis.

Subjects:

We examined healthy individuals between the ages of 20 and 55 years from the NHANES 1999-2008. Anyone under the age of 20 or over the age of 55 as well as pregnant women was excluded. For individuals to have been included they must have completed the information in the survey regarding age, weight, height, weight perception, current health status, and family medical history. A sample size of 7,497 participants remained after these exclusions

Data Preparation

Accuracy of Weight Perception:

The information used from NHANES included age, measured weight, measured height, self reported weight, self-reported weight status, current health diagnoses, and family medical history. Measured height and weight was used to calculate body mass index by dividing body weight in kilograms by height in meters squared (kg/m^2). BMI values were used to classify individuals in weight classifications presented in Table 1.

BMI (kg/m^2)	Classification
<18.5	Underweight
18.5-24.9	Normal Weight
25.0-29.9	Overweight
≥30.0	Obese

Table 1: Weight status classifications based on body mass index values.

Self-reported weight was compared to measured weight to assess accuracy of perceived weight to actual weight. To obtain the proportion of self-reported weight to actual weight, the following equation was used:

$$\frac{(self-reported\ weight)}{(actual\ weight)} \times 100$$

Self-reported weight was considered accurate if it is within 5% of measured weight, with underestimation and overestimation defined as a self-reported weight >5% less or more than actual weight, respectively. The data collected on self-reported body weight perception was collected as to whether they perceived themselves to be “Very Underweight”, “Slightly Underweight”, “About Right”, “Slightly Overweight”, and “Very Overweight”. To compare this answer with the calculated BMI classification, we considered the following perception and reality combinations as accurate: an answer of very or slightly underweight with BMI classification of underweight, an answer of about right and a BMI classification of normal weight, an answer of slightly overweight with a BMI classification of overweight, or an answer of very overweight with a BMI classification of obese. Finally, individuals were classified into accurate, over-reporters and under-reporters of weight status by comparing perceived and actual weight status classifications. For example, individuals who believed they were the right weight and had a BMI in the normal weight category were considered accurate reporters of weight status.

Family History of Chronic Disease:

The following diseases will be considered in this study as there is evidence of their relationship with obesity: type 2 diabetes mellitus, angina or cardiovascular disease, hypertension, and osteoporosis. Family history will be considered among immediate relatives (parent, sibling, grandparent, parents’ sibling).

Data Analysis

To assess the accuracy of self-reported weight, we correlated self-reported weight to measured (actual) weight using Pearson product-moment correlation. A frequency analysis was used to describe the proportion of adults by accuracy of self-reported body weight, using data for those within 5% of actual weight and by over/underreporting. A chi-square analysis was used to assess differences in accuracy by gender and race/ethnicity. Differences in self-reported weight status and accuracy (within 5% and over/underreporting) across presence of family history for each of the aforementioned diseases were analyzed using Chi Square analyses. Statistical significance was established at $P<0.05$.

Data was prepared and tabulated using SPSS/PASW (version 18.2, IBM SPSS Inc, Chicago, IL). To account for the complex sampling design used for subject selection and the oversampling of target populations, data analyses were conducted using the SPSS Complex Samples module (version 18, IBM SPSS Inc, Chicago, IL). This allowed for the results to represent a nationally-representative sample, using a CDC-generated sampling weight, while also producing sample-based standard errors for statistical testing.

Results

The following figure represents the correlation between self-reported and actual body weight. We found a strong correlation between the two, indicating that the general population is largely able to accurately estimate their weight within 5% of actual. This same correlation does show, however, that the more an individual weighs, the more likely they were to inaccurately estimate their weight, typically assuming they weighed less than they actually did. When the accuracy of

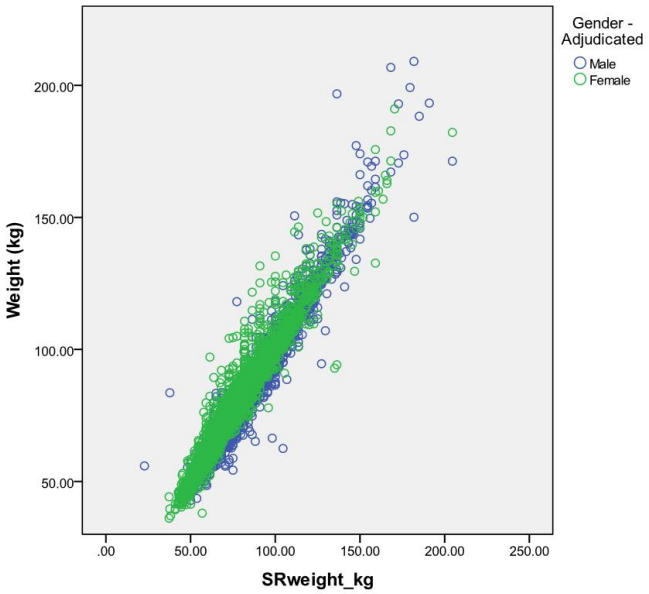


Figure 2: Self-Reported vs Actual Weight (n=7497)

weight perception of the general population was analyzed, 78% estimated their weight within 5% of actual. This leaves 22% of the population which was unable to accurately estimate their weight within 5%. The majority of inaccurate estimators, 13% of the total population, underestimated their weight. This represents about 17 million Americans who think they weigh less than they actually do. The figures for accuracy of weight perception based on gender and race/ethnicity were also analyzed and are listed below (significantly different $P<0.001$ for both).

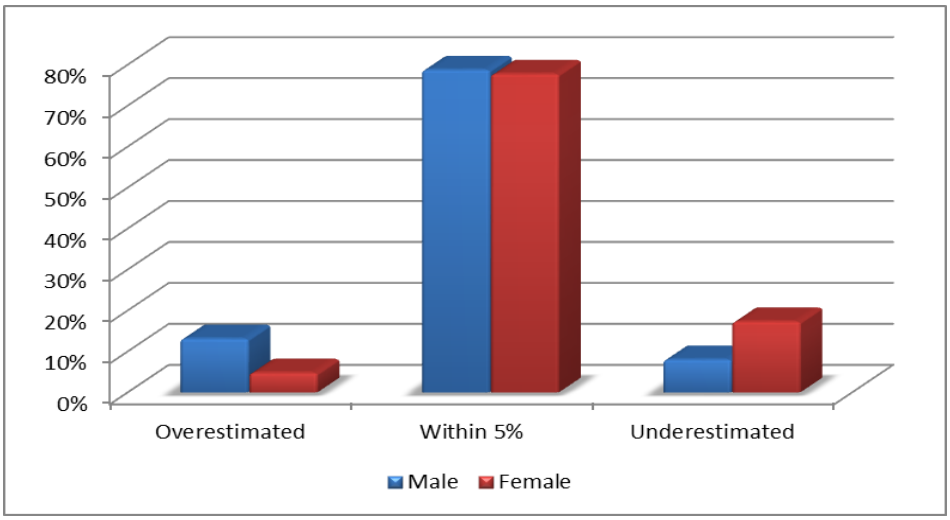


Figure 3: Weight Perception by Gender
(Male=3828, Female=3669)

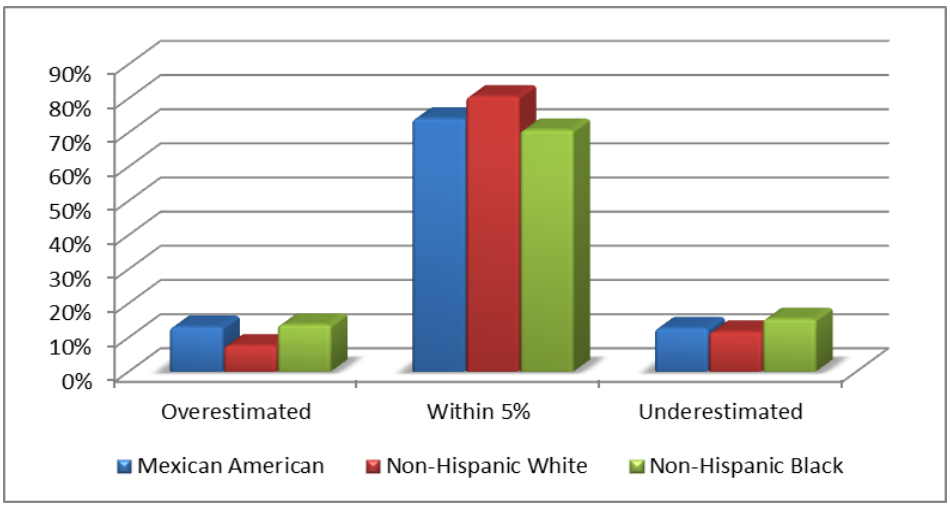


Figure 4: Weight Perception by Ethnicity
(Mexican American=1693, White=3460, Black=1663)

There were no gender differences regarding accuracy of weight perception. It is, however, interesting to note that women were more likely to underestimate their body weight while men were more likely to overestimate. Of the racial groups assessed (Mexican American, Non-Hispanic White, and Non-Hispanic Black) the Non-Hispanic White group was the most likely to accurately assess their body weight within 5% (81%) while the Non-Hispanic Black group was the least likely (71%). The Non-Hispanic Black group was the most likely (15%) to underestimate.

When weight perception was compared by BMI weight class we found that those who underestimated were more likely to be obese than any other weight category (48%). Those most likely to be accurate within 5% were from the normal weight and overweight categories (35% for each).

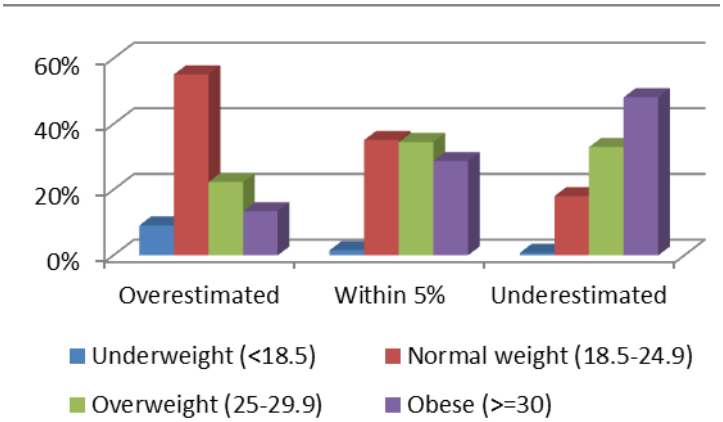


Figure 5: Weight Perception by Actual Weight Status

When weight perception accuracy was compared based on family history of chronic illness we found that individuals with a family history of each of the disease states were more likely to underestimate their body weight. This differs from the initial thought that those who have close relatives afflicted by these conditions would likely have a more realistic perception of their weight status. While only differences in family history type 2 diabetes showed statistical significance (p=0.018) the trends for each illness, as shown below, consistently present a trend with subjects being more likely to underestimate their weight if they had a family history of chronic disease.

	Overestimated	Within 5%	Underestimated	P
Diabetes	**46.3**	**49.9**	**54.1**	**0.018**
HTN	34.1	34.7	36.5	0.623
Osteoporosis	11.1	15.7	16.6	0.061
Angina (CVD)	14.2	15.9	19.4	0.073

Table 2: Weight Perception and Family History of Chronic Disease

Individuals with a family history of chronic illness were more likely to underestimate rather than either overestimate or accurately estimate their weight. Those with a family history of chronic illness appear to be less able to accurately identify their weight status than the general population.

Discussion

As rates of overweight and obesity rise in our society, it becomes increasingly important for healthcare professionals to understand the best approach to providing education to this population (4, 6). Because obesity and related chronic illnesses are becoming more prevalent healthcare costs are also escalating (7). Education is the critical component in stopping the rise of obesity, chronic disease, and health care costs. This study may help us better understand the best starting point for providing such education.

The results of this investigation which concern accuracy of weight perception based on the general population and various demographics reiterate what is largely already shown in literature. This includes our findings that obese persons are more likely to inaccurately estimate their weight. Racial, ethnic, and gender variances also influenced weight perception, similar to previous research findings (8, 9, 10, 11). One study showed that only about half overweight persons classify themselves as overweight while about 80% of obese persons consider themselves overweight (10). Individuals seem to understand that overweight and obesity leads to increased disease risk, however, it is not equally as well understood what classifies someone as overweight or obese (10). Understanding the relationship

between being overweight and being at risk for health problems is of no use unless you can accurately classify your weight status. A person must learn how to classify their own weight before they can make appropriate health related decisions. The difference between understanding health risk and understanding weight status may be attributable to what is seen as normal in both the American society as a whole as well as within population subsets. Our investigation showed that of the men and women who inaccurately perceived their current weight, consistent with previous research, men were more likely to overestimate (8). From our study, women were more likely to underestimate their weight status. This finding is also consistent with existing literature (8, 9). This may give some indication as to societal stigmas associated with how individuals perceive "normal" male and female body types because men may often wish to be larger and have a more muscular build while women tend to seek a leaner, more slender figure.

No information exists in the literature regarding the relationship between family history of chronic illness and accuracy of weight perception. We sought to draw conclusions on how to best educate individuals on health risks related to weight status based on the real world experiences, namely family history of chronic illness, which they had. We hypothesized that having a family member with a weight related chronic illness may make an individual more likely to have a realistic picture of their own weight status. One study showed that African American adults with a family history of chronic disease were more likely to understand their risk factors and more likely to engage in preventative lifestyle habits such as eating fruits and vegetables (19). What we found, however, was the opposite. Individuals with a family history of diabetes were significantly more likely to underestimate their actual body weight. Although not statistically significant, this trend was the same for osteoporosis, angina (CVD), and hypertension.

Also of interest is the fact that individuals who reported family history of any chronic illness assessed were much less likely than the general population to accurately assess their weight status with

only 16% of those with angina (CVD) and osteoporosis, 35% of those with hypertension, and 50% of those with diabetes accurately estimating their weight (compared to 78% of the general population). What we can conclude from these findings is that proximity to chronic illness is not enough to make individuals understand where they themselves fall on the health risk spectrum. Individuals with a family history of chronic illness face increased risk not only from genetic and environmental factors but also may be less likely to be motivated to engage in preventive lifestyle behaviors due being unable to accurately identify their overweight status, a key risk factor in the development of chronic illness (14, 17, 18, 19). Education on risk factors associated with increased body weight is useless if the individual does not know he or she is overweight. As awareness of overweight and obesity risk becomes more widespread healthcare professionals must avoid the assumption that the awareness has made its way to all persons. Because chronic illnesses often have a genetic component it may be easy to assume that individuals with family history of such diseases are sensitized to the risk factors (5, 14). We must continue to place increased emphasis on those groups who have been shown to be less likely to accurately assess their weight status especially because they are often the same groups who are already at increased risk for chronic illness.

Several limitations exist when using secondary data for these analyses. Because this study included the use of secondary data, analyses were limited to the data available. Because of shifts in the content of survey content across the two year cycles, omission of certain family medical history questions limited the sample size. Finally, the measurement of self-reported family history of chronic disease was limited by the knowledge and recall of specific family history. Further studies may improve on these points to help us better understand family history of chronic illness and its effect on weight perception.

While this study gives us a glimpse of considerations to make when assessing how to best educate on weight related health conditions more research is needed to create more definite

conclusions. Investigation into why individuals with family history of chronic illness are less likely to be aware of their weight status would give a better idea of the direction from which to base education. For example determining whether the poor perception is a sort of defense mechanism, stems from environmental or societal factors, or a combination of those things would paint a better picture as to how to bring these individuals up to date on not only the consequences of being overweight or obese but what overweight and obesity are. Extending this investigation to additional chronic illnesses such as cancer and cerebrovascular disease would broaden the scope and provide a more complete set of information. Because the relationship between weight perception and family history of chronic illness was not previously documented, more studies to replicate the results are necessary to substantiate our findings.

In conclusion, one should take from this study that emphasis should always be placed on the individual being educated rather than the condition or conditions which they may have. Individuals must be assessed for their level of knowledge regarding the risk for developing or the factors crucial in controlling a disease state in order to assure that key pieces of information are made clear. Although every person should be treated as an individual key demographic and other health related factors should be considered when establishing the level of health education. Understanding one's own weight status is an important part of the whole wellness and prevention philosophy. Omitting what may seem like common knowledge may be the difference between success and failure of health education if that knowledge is not understood by the patient.

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